

STEWART

Cost of Freight Transportation

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# THE COST OF FREIGHT TRANSPORTATION

...BY...


ROBERT JACQUESS STEWART

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THESIS FOR THE DEGREE OF BACHELOR OF SCIENCE  
IN MECHANICAL ENGINEERING

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IN THE  
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OF Bachelor of Science in Mechanical Engineering

*L. P. Brackernidge*

HEAD OF DEPARTMENT OF Mechanical Engineering

66156

9N64 Elliott







# The Cost of Freight Transportation

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## "The Cost of Freight Transportation".

### I Introduction.

During the century just closed, particularly the latter half, there has been an almost revolutionary change in the organization and methods of the productive industry; and, perhaps, the feature which made such great changes possible, the transportation element is of the greatest importance.

At the beginning of the century, the articles necessary for subsistence were, with few exceptions, raised wholly within the districts where they were consumed and those articles coming from a distance were rendered almost out of reach because of the risk and consequent expense attending their transportation. The prices of such articles were doubled, tripled and often quadrupled one hundred miles from the place of their production. The contrast offered now is almost incredible when one stops to consider in what even the laborer indulges. The common articles of his food may consist of meat raised one thousand miles from the packing house which itself may be several hundred miles from his town. His coffee may have been grown in Ceylon or Brazil; the fruit on the table may have been gathered in Mexico, Italy or California. He wears woollens made in Massachusetts and grown in Montana; his wife's silks were woven in France and his children's toys were made in Germany. Such a condition has been made possible only by the medium of transportation.

In fact, nearly all commodities of current use represent the combined productive efforts of those who create, respectively, form





utilities and place utilities; and the effect of the development of modern transportation agencies has been to give relatively greater importance to the production of place utilities. As railway transportation is regarded as the cheapest method of transportation, it has been and still is the greatest factor for the reduction of the total social cost of subsistence by permitting form utilities to be given to each commodity under the most favorable conditions.

There are almost innumerable examples of the changes wrought and the advantages gained through transportation, but space does not permit discussion. In fact it is the purpose of this essay only to collect and briefly discuss some principal points pertaining to the subject, leaving those who may be interested to consult the many excellent sources available.



Explanation of Statistics.

Work is defined as the product of a force into the distance through which it acts. It is easy to conceive that transportation may be expressed in somewhat similar units. Hence, Transportation may be defined as the act of conveying a certain quantity of matter over a certain distance. As it is most convenient to use the ton for expressing weight, and the mile for denoting distance, the unit of transportation- the product of the quantity and the distance- is the Ton Mile. This unit is used in the compilation of all statistical reports and the transportation of all individual lines is always expressed in the "number of ton-miles" or the "number of tons per mile of line". Other units are used such as the "train-mile", but these are only "ton-miles" in a different form.

The Inter-State Commerce Commission has divided the country into ten different sections, and as the conditions vary in each section, the discussion will be based as far as possible upon this division.





Ratemaking in Practice.

With the opening of the first transportation line, the rate problem came into existence . The first means of transportation was by horse or mule and the rates were excessive and would at present seem exorbitant. Following this came the more modern methods of transportation, the steam railways which slowly extended their lines as pioneers throughout the western part of our country. The growth of the railway mileage in the United States has been very rapid. With a total of 23 miles in 1830, in seventy two years ( less than three quarters of a century) the growth exceeds 202,475 miles- the largest annual increase being in 1887, when the mileage increased 12,876 miles.(See Chart I).

With this increase in mileage the opportunities of the exchange of commodities were increased and the trade stimulated to such a degree, that the output began to grow with even increasing rapidity.

The rates first established by the railways which though much greater than most roads find themselves able to charge and while based on the old system of animal transportation, were so much less than the residents tributary to the new roads had been formerly obliged to pay that they were hailed as eminently satisfactory by the patrons. The rates under these conditions are seldom continued for any length of time. As the rail facilities increased means of communication with the localities increased to such an extent that the expansion of trade increases at once. Farmers increase their output, and the railways to stimulate the output lower their rates.



CHART-NO. 1.

INCREASE OF R.R. MILEAGE  
IN THE  
UNITED STATES  
1830-1900

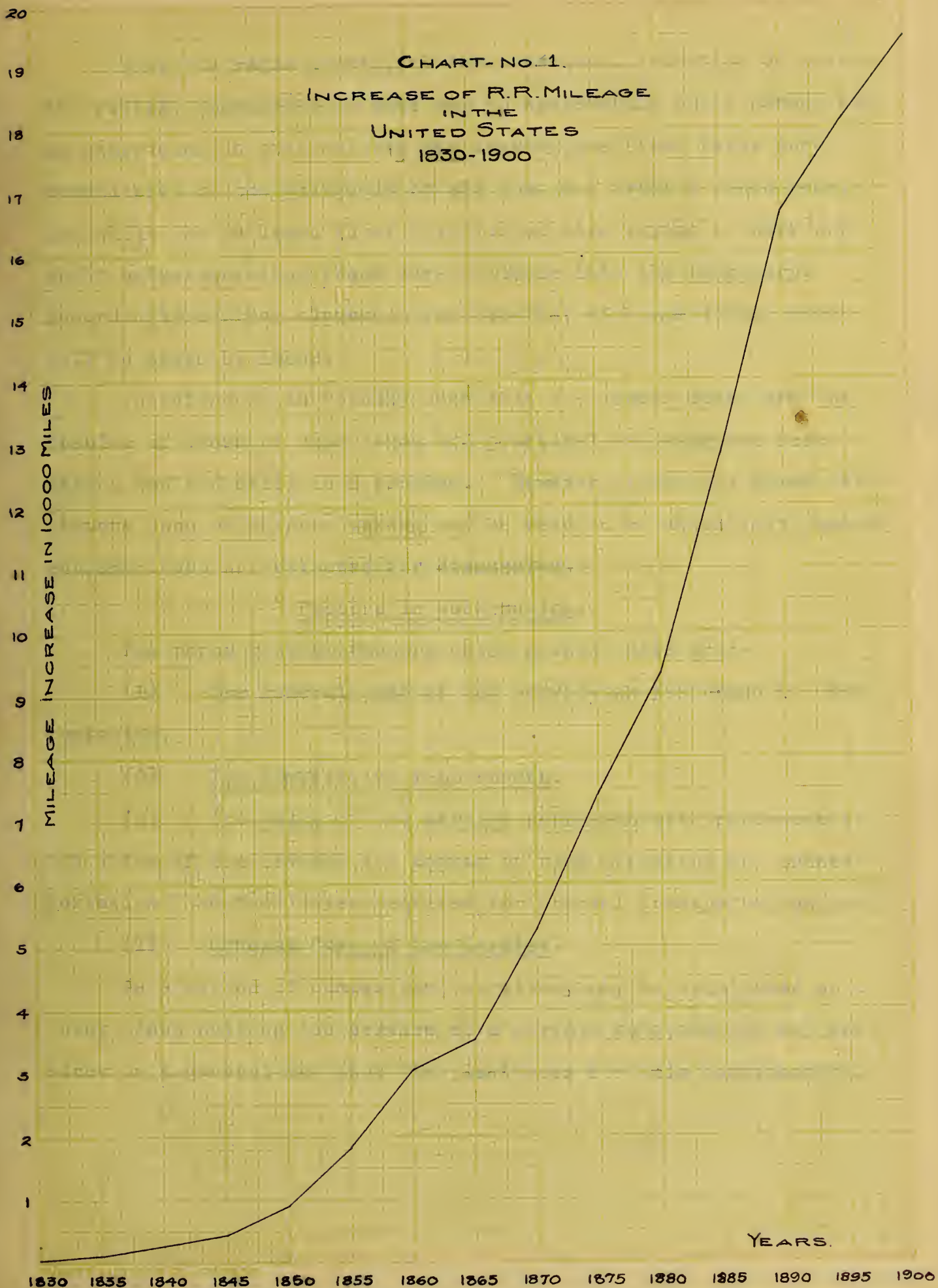
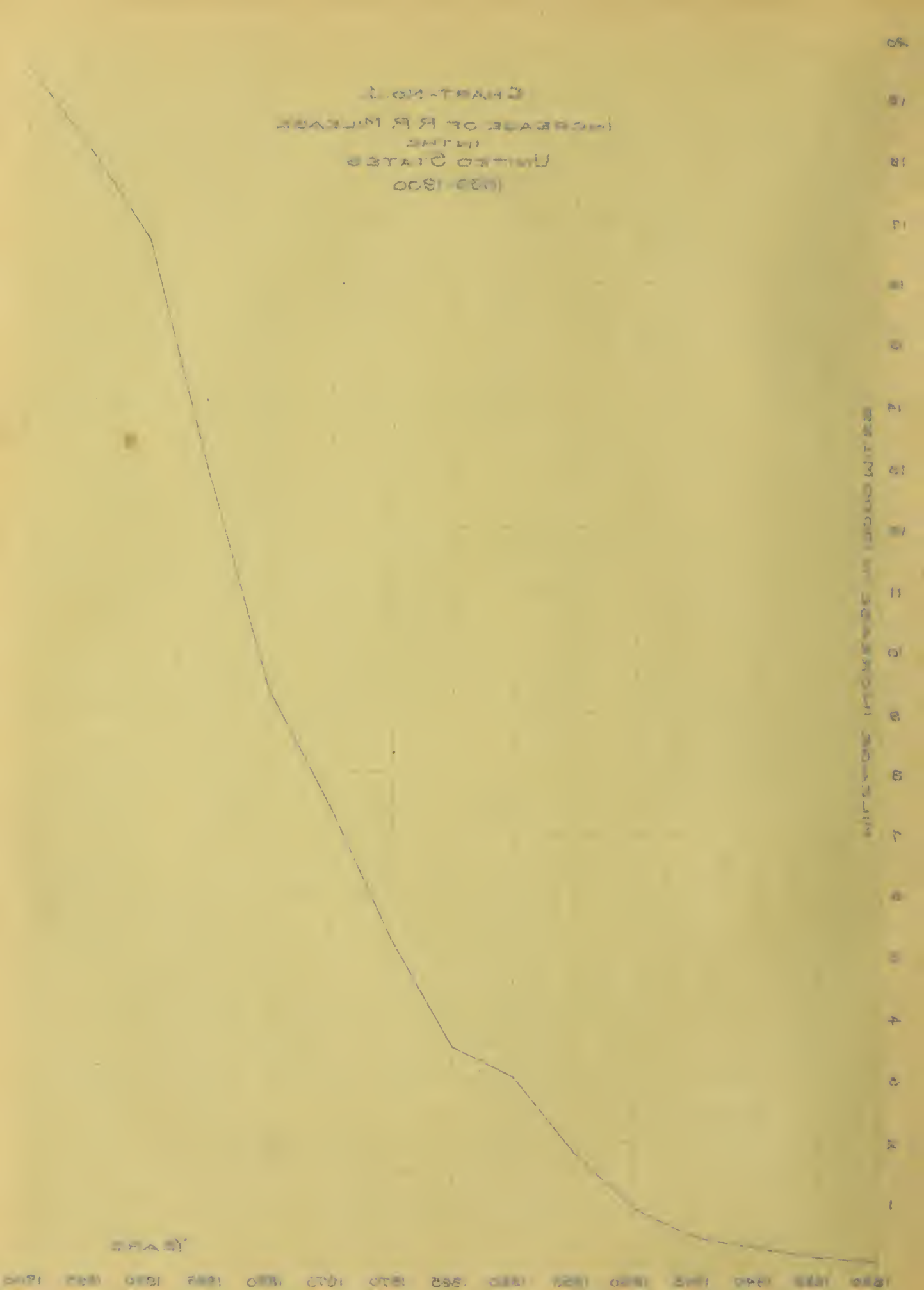


CHART NO. 1  
 INCREASE OF R. R. MILEAGE  
 IN THE  
 UNITED STATES  
 (1850-1900)

PERCENTAGE INCREASE IN RAILROAD MILEAGE

1850 1860 1870 1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000





With the rapid growth, and the consequent reduction of rates, the railway endeavored in some way to systematize their rates; but as experience in such matters was lacking, the first rates were established on the principle of all that the traffic would bear; and while the railways first established were trying to work out their salvation, other roads were building into the territory. Accordingly, another element introduced—that of competition—which will be taken up later.

Therefore it is readily seen that modern rates are the results of years of experience and practical thinking, and rate making was and still is a problem. However, there are three main factors upon which rate making may be said to be absolutely dependent, and these are selected for discussion.

#### Factors in Rate-making.

The three general factors which govern rates are:-

- (1) The general cost of the service as performed by the companies.
- (2) The competitive requirements.
- (3) The value of the service performed with reference to the value of the freight, the degree of risk attending the transportation; the facilities required for special transportation, etc.

#### (1) General Cost of the Service.

As a method of comparison, a railway may be considered as a power plant selling its service at a certain rate, and one may consider in a general way what the plant does for this compensation.



Firstly, the railroad has to maintain in good condition its roadbed; its bridges; tunnels and embankments; and its crossings, fences along the line and culverts. Also, it is obliged to maintain its equipment consisting of locomotives and cars together with the shops and machinery necessary for their repair. This, perhaps may be said to be the part of the plant actually producing the transportation.

In the second place, the railroad provide and maintain very costly terminals, depots and receiving stations for freight before transportation, and distributing depots after the freight has completed its passage. It maintains expensive freight yards for the making up of trains in order to secure efficiency of train service. This part of the plant while it does not actually produce transportation smooths the way and prepares it for its production.

Again the railroad employs a large force on men to conduct its transportation; another force to collect freight and secure business for the road. It has superintendents who supervise the work of all the departments. It operates the telegraphic department in connection with its work; it may operate a lighterage equipment for ferry service and it may do a multitude of other things to further its service that cannot be mentioned in this discussion.

In general then, the railway as a plant has to maintain itself at a large expense in order to sell its services.

It is evident from this general statement of facts, that an almost infinite number of factors enter into the cost of the service both preparatory to the work done and in direct transportation. In endeavoring, therefore, to determine actual units of cost, a highly complicated organization has to be dealt with and hard and fast





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rules cannot be laid down. It is also evident that an apportionment of expenses between freight and passenger business is just as complicated and to say the least, somewhat inaccurate varying in almost every report. Hence, at this stage of the discussion, no effort will be made to distinguish between the two. However, as the expenses due to freight transportation is far in excess of that due to passenger traffic, an enumeration of the costs of the service as a whole will give a considerable insight into the expenses incurred by the freight traffic.

As has been indicated previously, the Cost of Service is divided into several main sources of expenditures. With the expense account of the railways as a source of information, it was found that the expenditures were classed according to their relative importance under four main heads. Namely, the cost of transportation due to

- (a) Conducting Transportation
- (b) Maintenance of Way and structure.
- (c) Maintenance of Equipment.
- (d) General Expenses.

In order to show and briefly discuss these four main heads, they will be taken up in order of their precedence as indicated.

- (a) Conducting Transportation.

In 1902, fifty four and sixty seven hundredths (54.67) per cent of the total operating expenses of the railroads in the United States was dispensed for conducting their transportation. This per centage, as would be supposed, is divided among a number



of different items of expense. As a source of interest as well as information, the following list of a few important items, as taken from the I.S.C.C. report, is given.

<u>Item</u>	Per cent
Locomotives -----	21.38
Fuel for Locomotives -----	10.78
Engine & Roundhouse men -----	9.40
Water Supply -----	.62
Supplies-oil,waste -----	.58
Train Service and Supplies -----	7.24
Station Service & Supplies -----	7.51
Switchmen,Flagmen,Watchmen -----	3.98
Superintendence-----	1.71
Car Milage-Balance-----	1.48
Injury to Persons-----	1.05
Outside Agencies-----	1.58
Telegraph-----	1.74
All other expenses-----	

The last item includes about thirteen items of minor importance such as; Rents for Tracks; Stock Yards and Elevators; Stationary and Printing chargeable to this department; etc. It may be seen that as a little more than one fifth of the cost of transportation due to conducting it is directly chargeable to the Locomotive, great stress should be laid on its increased efficiency. That such is the case at the present time, no proof is needed as the effort in this direction is recorded in all the technical periodicals and even in the current publications.



(b) Maintenance of Way & Structure.

Again, according to the statistics of 1902, twenty-two and twenty six hundredths percent (22.26%) of the total expenditures of the railroads of the United States were chargeable to maintaining the roadbed and structures along the right of way. To this head, certain items are chargeable, some of which are indicated in the following list.

Item	Percent
Repair of Roadway -----	11.33
Renewal of ties and rails -----	4.36
Repair and Renewals of bridges and culverts -----	2.59
Repair and Renewals of buildings and fixtures -----	2.56
Repair and Renewals of fences, signs, guards etc. -----	.63
All other expenses -----	.79

The last item includes such items as; repairs and renewal of telegraph, docks and wharves, and a few incidentals.

The most important item of expense due to this head is the repair of the roadway which depends on the materials used in its construction and the manner of construction. But a great part of this expenditure may be assumed as the expense incurred by decreasing grades and curves having in mind the decrease of locomotive power, decrease in the wear on the track and increase speed in passenger service.

(c) Maintenance of Equipment.

The expenditure due to the maintenance of equipment in 1902 was nineteen and thirteen hundredths per cent (19.13%) and was divided among the following important items:





Item	Percent
Repair and Renewals of freight cars-----	7.43
Repairs and Renewals of locomotives-----	7.25
Repairs and Renewals of passenger cars-----	--2.16
Repairs and renewals of Shop machinery-----	.64
All other items-----	.65

The items of greatest importance under this source of expense are those chargeable to the car and locomotive service. As to the former, reference need only to be made to the publications which indicate ever growing tendency toward the use of steel in construction. While this increases the first cost, it decreases the cost of repair and has other advantages to be spoken of later.

With the addition of the per cent indicated in this list of the locomotive service, the total per cent chargeable to this branch of the transportation element is 23.63%-nearly 30%. Such an amount serves to indicate the importance which should be attached to it.

Another way which indicates the expense of the locomotive service is the cost per mile. The following list will give a comparative estimate taken from three representative railway systems.

#### Pennsylvania Railway.

Year	Division	Total	Repairs	Fuel	Stores	R.E.
1898	all	.1323	.466	.684	.022	.151
1899	"	.1347	.490	.0694	.022	.141
1900	"	.1544	.0581	.0791	.024	.148
1901	"	.1647	.0622	.0853	.024	.148



## Wisconsin Central

Average Cost in cents per mile.

Year	Total	Repairs	Fuel	Stores	Wages
1899	18.97	3.39	8.11	.18	7.29
1900	20.06	3.47	8.83	.20	7.54
1901	22.33	4.23	9.98	.23	7.89
1902	23.60	5.33	9.87	.25	8.15
1903	26.67	5.65	12.28	.26	8.48

## Union Pacific

Years	Total	Repairs	Fuel	Stores	Wages
1903	34.33	10.39	12.49	1.53	9.92

Some other items of cost prove interesting- the miles run per ton of coal and per pint of oil. The reports of the Wisconsin Central and Union Pacific give the following estimate

## Wisconsin Central

Year-	Cost of Coal-	Miles run per ton-	Miles per pint of oil
1899	.67	20.62	21.30
1900	1.28	19.69	18.93
1901	1.28	20.20	17.67
1902	1.04	18.68	16.49
1903	.956	15.99	17.05

## Union Pacific

Year	Cost of Coal	Miles run per ton	Miles run per pint of oil
1903	1.75	14.04	14.35



Of course, these estimates vary with the average mileage of the locomotive but the greatest variation was only a few miles in five years as recorded by reports examined- the average monthly run being about 3,400 miles.

(d) General Expenses

This fourth and last division of the "General Cost of Service" incurs an expense amounting in 1902 to three and ninety five hundredths percent (3.95%) of the total operating expenses and are enumerated below:-

Item	Percent
Salaries of General Officers	.935
Salaries of Clerks and Attendants	1.24
Law Expenses	.56
Insurance	.41
General Office expenses	.41
All other expenses	.40

Compared relatively, the General Expenses have been affected more than any of the other factors. Referring to Chart II it is found that while new duties for the clerks and other members of the general office force have increased, the total percent expenditures have steadily decreased. This is, purely and simply a direct result of combination.





CHART-NO. 2  
DISTRIBUTION OF OPERATING EXPENSES  
OF  
RAILWAYS IN THE UNITED STATES  
IN  
1902

SOURCE OF EXPENSE	ITEM	PERCENT OF TOTAL EXPENSES
CONDUCTING TRANSPORTATION	TOTAL	
	FUEL FOR LOCOMOTIVES	
	ENGINE AND R. HOUSE MEN	
	ENGINE SUPPLIES	
	TRAIN SERVICE AND SUPPLIES	
	STA SERVICE AND SUPPLIES	
	SWITCHMEN, FLAGMEN, ETC.	
	SUPERINTENDENCE	
	CAR MILEAGE - BAL.	
	INJURY TO PERSONS	
	OUTSIDE AGENCIES	
	TELEGRAPH	
	ADVERTISING	
	ALL OTHER EXPENSES	
MAINTENANCE OF WAY AND STRUCTURES	TOTAL	
	REPAIR OF ROADWAY	
	RENEWALS RAILS-TIES	
	BRIDGES AND CULVERTS	
	BUILDINGS AND FIXTURES	
	FENCES, GUARDS, ETC.	
	ALL OTHER EXPENSES	
MAINTENANCE OF EQUIPMENT	TOTAL	
	FREIGHT CARS	
	LOCOMOTIVES	
	PASS. CARS	
	SHOP MACHINERY	
	ALL OTHER EXPENSES	
GENERAL EXPENSES	SALARIES - GEN. OFFICERS	
	SALARIES - CLERKS, ETC.	
	LAW EXPENSES	
	INSURANCE	
	GEN. OFFICE EXPENSES	
	ALL OTHER EXPENSES	
	TOTAL	

CHARTERED  
 DISTRIBUTION OF OPERATING EXPENSES  
 OF  
 RAILWAYS IN THE UNITED STATES  
 IN  
 1905

PERCENTAGE OF TOTAL EXPENSES		ITEM	PERCENTAGE OF TOTAL
Operating Expenses	Operating Expenses	Salaries and Wages	15.0
		Freight	12.0
		Passenger	10.0
		Material	8.0
		Depreciation	7.0
		Interest	6.0
		Taxes	5.0
		Insurance	4.0
		Repairs	3.0
		Light and Power	2.0
		Postage	1.0
		Telephone	1.0
		Advertising	1.0
		Other	1.0
		Total	100.0
Maintenance of Way and Equipment	Maintenance of Way and Equipment	Track	40.0
		Rolling Stock	30.0
		Buildings	10.0
		Fences	5.0
		Signs	5.0
		Tools	5.0
		Other	5.0
		Total	100.0
General Expenses	General Expenses	General	5.0
		Legal	5.0
		Insurance	5.0
		Postage	5.0
		Telephone	5.0
		Advertising	5.0
		Other	5.0
		Total	50.0
Other Expenses	Other Expenses	Interest	10.0
		Taxes	10.0
		Insurance	10.0
		Repairs	10.0
		Light and Power	10.0
		Postage	10.0
		Telephone	10.0
		Advertising	10.0
		Other	10.0
		Total	100.0



## Determination of the Cost of Freight Service.

While it may seem almost paradoxical, it is never-the-less true that with the exception of lines having a large ton-milage, it was almost impossible to find the actual cost of transporting a ton of freight one mile.

The Interstate Commerce Commission says " Whenever there has been an attempt to find the actual cost of transporting freight it has been laborious and not at all accurate and the best estimates have been arrived at roughly by making, arbitrarily, allowances and assumptions" It is easily seen that the cost chargeable to the freight may vary in almost as many cases as the number of estimations. Different roads may or may not charge the same item or the same per cent to freight transportation. The latter may also vary greatly with the territory. For instance, there are railroads in operation, as the coal roads of Pennsylvania which haul only freight and there are other roads such as the New England railway in Group I where there is more passenger than freight traffic. Again, there is no exact method whereby the amount chargeable to the different items of general expenditure to the account of freight traffic. It is plain enough that the proportion of the total expenses due to the freight service is more than the passenger service and that a greater percent should be charged to this branch of the service. Knowing the different items of expense, it is possible by properly distributing the different items to compute the cost of a ton-mile. But to do this requires experience and a vivid insight into those various items of expense. And why would not the men whose business it is to allot to each branch of service its proper proportion of the total expense vary a great deal in their views of what was the just amount to charge



CHART-NO 3  
 AVERAGE COST PER TON-MILE  
 ON THE  
 PENN. R.R.  
 1865-1900

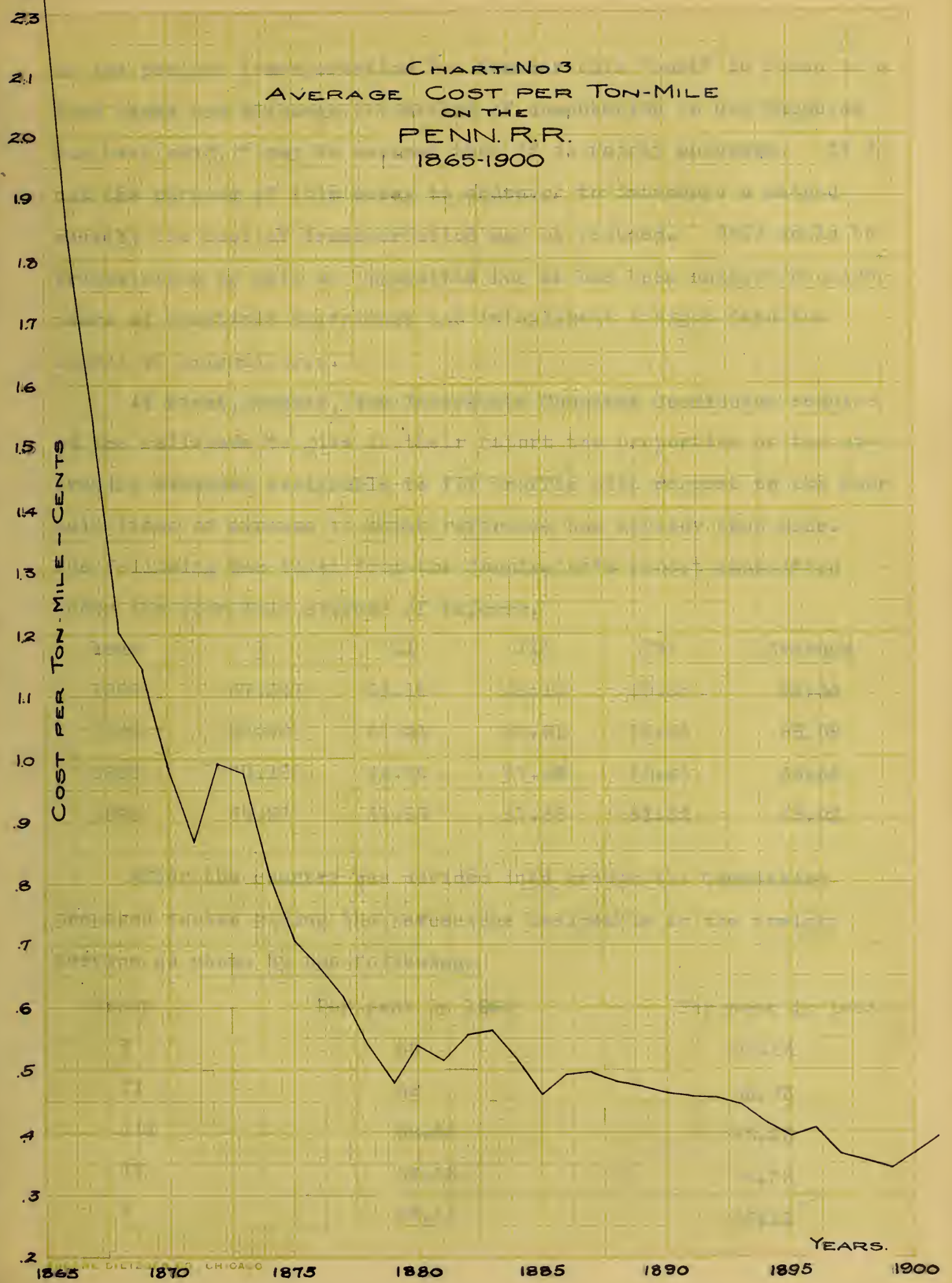
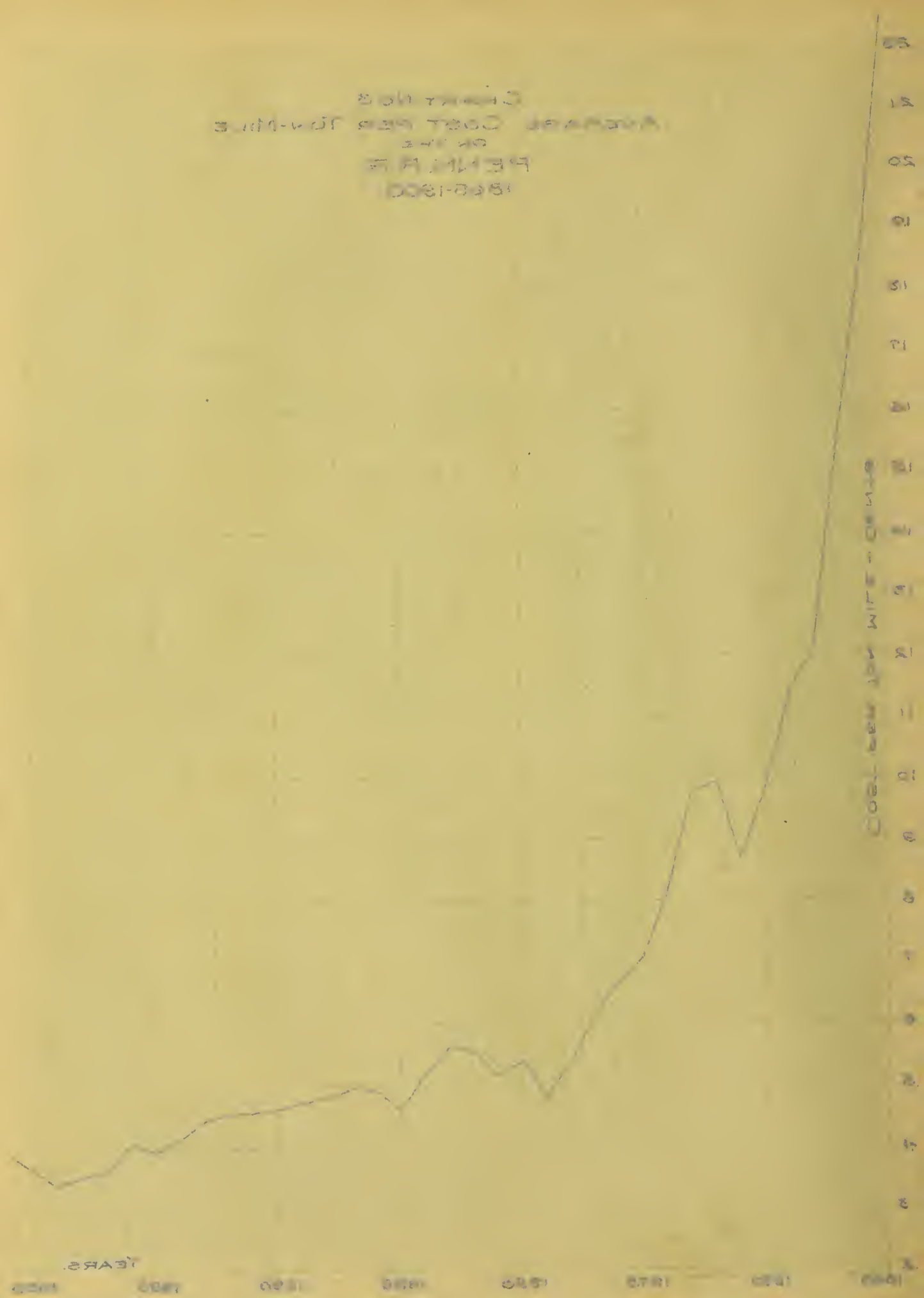




Chart No. 3  
Average Cost per Ton-Mile  
of the  
PENNSYLVANIA  
1860-1900



to the freight transportation ? However this "cost" is found in some cases and although the method of computation is not known, as has been said, it may be assumed that it is fairly accurate. It is not the purpose of this essay to endeavor to introduce a method whereby the cost of transportation may be reduced. This would be preposterous as well as impossible for as has been said, it requires years of practice experience and intelligent insight into the source of expenditures.

At first, however, the Interstate Commerce Commission required the railroads to give in their report the proportion of the operating expenses assignable to fit traffic with respect to the four main items of expense to which reference has already been made. The following was taken from the Commission's report classified under the four main sources of expense.

Year	I	II	III	IV	Average
1888	67.547	62.15	66.14	60.95	66.36
1889	67.92	61.21	66.81	59.63	65.08
1890	70.18	62.90	67.96	61.45	66.38
1891	69.27	61.50	67.66	61.32	65.92

After the country was divided into groups, the Commission prepared tables giving the percentage assignable to the freight service as shown by the following-

Group	Per cent in 1892	Per cent in 1893
I	52	53.24
II	68	66.73
III	68.85	68.28
IV	66.68	66.33
V	67.86	66.11



Group	Per cent in 1892	Per cent in 1893
VI	68.60	68.22
VII	66.83	66.63
VIII	68.42	68.68
IX	71.84	72.92
X	<u>58.46</u>	<u>57.46</u>
Average for the U.S.	66.51	66.15

From this table, it can be seen that the proportion varies in the different sections as one would naturally suppose that it should vary and notwithstanding the discontinuance of this section of the Commission's report, it gives an insight into the question under discussion. By comparison of the average proportion for the country as a whole, the proportion assignable to the freight traffic is practically the same-namely 66%. Mr. Woodlock in his book on the Ton-mile Cost says "The amount of energy directly employed in the unit of service or work done tends to constancy!" The report of the Pennsylvania Railroad Company was taken and the ratio between the total expenses and that proportion assignable to freight service tested. This was found to be practically constant (about 69%) for a period from 1865-1901 and the ratio between the expense due to transportation of freight and the ton miles of freight carried was the ton-mile as given in the report and shown by Chart No. 3

Therefore it is first necessary properly to apportion the expense and as the ton-mileage is known the cost per ton-mile is found.

We may summarize what has been said on the determination of the cost of the freight service as follows:

- 1- It is impossible to determine absolute ton-mile cost in any





case.

2- Only on a road doing a large amount of business is it possible to determine approximate ton mile cost since the more dense the business done, the more correct becomes the factors and the more accurately do they tend to measure or govern cost.

3- That the cost varies with the section considered.

4- That the proportion of the total expenditure assignable to freight traffic tends to constancy and is probably an average of about 66% through the United States.

In conclusion, it may be stated that since the cost varies as the circumstances vary all the time, a pre determination of a ton-mile cost is absolutely impossible.

## (2) Competitive Requirements.

Mr. J. F. Hudson defines Competition in commerce as "the rivalry of producers, merchants, and carriers; each of them striving to secure business by holding out superior inducements for the employment of his services". The "superiority" may be either in quality or promptness of service or cheapness of the same. In any case, however, the purpose of competition in transportation as well as in manufactures or trade is to secure patronage by doing more for the same money than any rival. Hence, it may be said that competition seeks to increase profits by enlarging the volume of the business done so that a small profit yields greater returns than a larger margin on a small volume of transactions; and while its operation enhances increased gains to lawful enterprises, the railway interest seems to have repeated the old adage that "competition is the life of trade"-at least the practical denial of it is so general in the present combinations and pooling organizations, that in the modern railway world competition is not found except among





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the large organized groups composed of the leading interests. In fact, at present, there is practically no absolute free competition existing.

There is no doubt that competition has an influence on a railroad policy and rates; but actual cases exist on all railroads where no direct competition exists. The railroads have no monopoly over transportation as a whole, but each railroad does have a monopoly over that traffic along its own line that cannot take other routes- that it is privileged to do as it pleases as regards its local traffic. It may charge two or three times as much in proportion to the distance as it does for competing points; it may assess upon this business any rate which according to its judgment the traffic will bear; or it may charge to the local point the full rate for hauling it through the local station to the terminus of the road and hauling it back again. This local business while it may seem, and generally is, small at each station, is great in the aggregate. It has been said that of all the railway traffic in the country, "there is not five percent that does not at some point experience the absence of competition. Take for example, a manufacturer whose plant is located where two or more railroads compete for his business. He may not feel it on the shipment of his products; but the raw material from which the product was made, the coal, ore, pig iron or cotton has felt it at some point. Again, the shipment of grain from a western city often gets the full benefit of competition; but the grain has suffered the effect of exclusive control at the local station where it was first shipped and where the rate for carrying it a hundred or two hundred miles to the nearest competitive point may be as much as the charge for transporting it from the point to the seaboard 1000 or 1200 miles



away. Hence, the shipper who starts freight at local points has no check upon the absolute rule of the carrier except as it may be influenced by what the traffic will bear or by a remote hope that another parallel line may be built into the territory and share the way business of the then existing line.

While competition is excluded from the vast volume of traffic at local points, it is the fight for the long distance traffic into which competition enters as an important factor. The through freight traffic is the kind of freight transportation which produces the greatest ton-mileage and hence the greatest revenue. As the railway mileage of the United States has increased the number of routes which commodities may take in being transported over long distances have correspondingly increased and the competition for this kind of traffic has resulted. It is at this point in the discussion that the form of competition involved is changed from that between competing points over a short distance and between parallel lines to the competition in which several roads are involved providing the carrier is not enabled to transport it over its own lines to its final destination or the point of shipment. This competition has given rise to all kinds of pooling and traffic agreements and the competition of long circuitous and "commercially illegitimate" routes for traffic that would naturally traverse cheaper and more direct lines. Mr. Newcomb in his volume on "Railroad Economics" gives several examples of such routes which serve to illustrate the indirect routes that traffic may follow. He says, "Between St. Paul and Chicago, with a short distance of 373 miles, traffic is carried by a line 734 miles in length. From Chicago to New York, twenty one routes ranging from 912 miles to 1376 miles compete for traffic while between Omaha and San Francisco,





there are five of which the shortest is 1865 miles and the longest 2724 miles. Besides the numerous regular and "tramp" steamships available for shipments from New York to New Orleans, more than ninety all rail lines are each actively seeking a share in the business. The most direct of these is 1340 miles in length or 711 miles shorter than the longest. As an example of competitive train service, it is not necessary to add to the bare statement that forty four trains leave Chicago for New York every day and that similar duplication of service exists wherever the same cities are connected by competing railways". As has already been said this form of traffic is the most profitable because of the reduced cost of its transportation per ton-mile. It requires smaller terminal charges and less special accommodation, and it represents a greater ton-mile revenue; but it must be remembered that it also requires a large expenditure for outside agencies and advertising. These expenses now so reluctantly incurred are impossible of reduction or elimination from the cost of railway operation; and if totally eliminated, would accrue to the benefit of the general public through further reductions in rates. .

The field of action of competition which if allowed to exist would have been very broad indeed; but, as has been suggested, its independent action is confined as between the large railroad groups which still further retain it by interline agreements which, while unlawful, exist to a greater or less degree. Interline agreements are accomplished in one or more of four ways. 1. Agreement to maintain certain rates. 2. A division of the competitive traffic among the interested roads according to certain agreed percentages. 3. A division of the total earnings of the interested lines that





have been derived from the competitive traffic according to specified ratios. 4. A division of the field, each company receiving a section of the country within which it is to conduct its business unmolested by the other companies in the agreement. The first form is the one easiest to adopt and was the first employed by the railroads to regulate their competition. The second and third forms are called pooling and up to the time of the establishment of the Interstate Commerce Commission was actively employed by the existing railway systems.

It is possible still further to detail how competition affects ratemaking but enough has been said to show the fact that it plays a most important part in rate determination. Hence allowing this brief discussion to suffice for this paper we consider

### 3      The Value of the Service Performed.

This third and last general factor of the cost of transportation while by no means of less value in the formation of rates than the other factors, from the fact that its application is comparatively clear, will receive only brief discussion.

When one stops to consider the vast variety in the kinds of freight offered for transportation and also the variety of facilities required for moving it, the fact that this factor is one of importance is more clearly seen. Hence in determining the rate that a certain article will fairly bear the value of the service based upon the character of the article, what risk there is attending its shipment, what special facilities it requires during its shipment and its value as a production must necessarily be taken into account. In justice to the carriers, it must be acknowledged as fair and right for them to charge specie a much higher rate than coal,



although in practice specie is more convenient and economical to handle. A car load of specie may pay more for transportation than a train load of coal and fairly so. A train load of high class furniture will pay more than a train load of iron castings or pig iron for the same reason. Again, perishable freight and stock and such other business involving large terminal expenses and risk in transportation will pay more than business not involving risk and such expenses.

Again, another factor upon which "the value of the service" is based is the amount offered at one time and the distance to be carried. Practically, all traffics provide a higher rate for freight offered in "less than car-load lots" than the same freight in "car-load lots" for obvious reasons. Anything tending to decrease the number of large shipments and increase the number of small shipments of the same class of freight will tend to increase the average ton-mile revenue for such freight although there will be no change in the number of ton-miles.

The value of the service rendered with reference to the character of the freight, its degree of risk attending transportation and the facilities required, the amount offered for transportation and the distance to be carried for a greater part form the basis of all the "Freight Classifications" in use at the present time. However, since the commercial and the transportation interests of the country are regarded as identical and the welfare of the whole territory and all the interests effected must be considered. The Freight Classifications are to a small degree a series of compromises. Not alone the railroads but also the shippers and business interests throughout the country join in classifying the freight.



Without entering into any discussion, it might be said that at present there are three general Freight Classifications in use throughout the United States namely the Official Classification, The Southern Classification and the Western Classification-all operating in prescribed territory under the direction of Committees stationed respectively at New York City, Chicago, and Atlanta Georgia. Besides these, there are classifications published by the R.R. Commissions of Illinois, Iowa, Georgia, North Carolina and Florida applying to shipments moving between points in those states.

To illustrate the classification of freight, extracts from the Iowa R.R. Commission report of 1901 may be given. These will serve to indicate the points just brought out. From the extracts it will be seen that every article is taken separately, and assigned to a class which varies as to whether the consignment be in "car load lots" (C.L.) or "less than car-load lots" (L.C.L.)

<u>Articles</u>	L.C.L. - C.L.	
Brass Articles -----		
Bars, Tubing, Flues, rolls-boxed- -----	2 -	4
Castings -----	2 -	D
Ingots -----, 3 -	3 -	4
Vessels -----	2 -	3
Brick		
Enameled-----	4 -	B
In boxes-----	4	
Paving-----	D -	D
Canned Goods		
Pickles, Kraut, Tomato, etc.-----	4 -	5

In this classification is grouped every article that may be





shipped and the conditions in which it may be offered. By reference to the table of maximum rates, an extract of which is given below, the rate for any class may be found.

Miles	Mdse. in cents per 100 lb.					Special Carload Classes in cents per lb.				
	1st.	2nd.	3rd.	4th.	5th.	A.	B.	C.	D.	E.
5	14	11.9	9.3	7	4.9	5	4.9	4.2,	3.5	2.8
10	14.8	12.6	10.1	7.4	5.2	5.3	5.2	4.4	3.7	2.96
25	17.	14.5	11.3	8.5	5.95	6	5.95	5.1	4.25	3.4
100	24	20.4	16.	12	8.4	9	8.4	7.2	6	.48

(In the table are given rates for every 5 miles from 5- 500)

It may be at some future time that some one expert in the matter of freight rates will arrive at some conclusion whereby the value of the service rendered will be established upon some practical basis, but at this time the patrons must leave it to the judgment of the companies and the commissions appointed for rate adjustment.

#### Some of the Probable Causes in the Reduction of Freight Rates

Having discussed in the preceding pages the question of rate making to some extent and incidentally the decline of rates, this paper would hardly be complete without at least an attempted discussion of some of the probable causes of this continued reduction in freight rates.

The increasing use of the transportation facilities is both a cause and a result of the reduced prices at which those facilities have become available for public use.

After the Civil War, it seems that all the railroads of the country quickly and eagerly grasped the fact that their tonage



could be multiplied by stimulating shipments by the reduction of rates. The cost of a railroad which moves 800,000 tons per mile of line is not materially greater than that of another railroad the traffic of which is relatively meager and the total expenses by no means vary in the same ratio as the traffic. In consequence of this fact each increment of traffic permits the distribution of expenses among an increased number of tons and ton-miles and thus reduces the average amount of cost assignable to each source of expense. This, which is no less than the "law of increasing returns" as applied to railway business signifies that without changes in rates increased traffic tends to increase gross earnings faster than expenses and consequently to produce increased profits. The absence of such profits is due to the fact that the benefits of the savings per unit have accrued to railway patrons through reduced charges instead of the owners of railway securities through higher rates of interest and of dividends. Mr. H. T. Newcomb in referring to the increase in traffic per mile of line during the decade just passed says "During the year 1867 railways having a total length of 15,651 miles or 42% of the entire mileage then in operation carried an aggregate traffic of 279,712 tons one mile per mile of line. These roads included those in the most developed sections of the country and having the densest traffic so that the average for the entire country was probably considerably lower. In 1872, the average was 331,958 or 61% of the railway mileage; in 1877, 345,773 on 77%; in 1882, 457,016 on 80%; in 1887, 513,513 on 78% and in 1892 and 1896 543,365 and 523,832 respectively on practically the total mileage of the United States. The decrease from 1892 to 1896 is attributed to the general business depression and





the fact that it was accompanied by decreasing rather than increasing charges is due to the severe economies practiced and the almost universal impracticability of advancing rates" Still further to illustrate the growth of the freight traffic, according to the report of 1890 on the 158000 miles of railroad 619,165,630 tons were carried while in 1901, the 194,455 miles of railroad in the United States transported 1,034,066,451 tons of freight. That the aggregate tonage should in so short a period almost double itself while the mileage increased only 18% serves to force a conclusion that herein is the probable reason for the decline of rates.

But if the increase in traffic was not accompanied by relative economies in freight movement the reduction of charges to such a degree as they now occur would be practically impossible. In other words, the decline of rates has been accompanied by a decrease in the cost of the ton-mile. This factor is principally the result of three distinct elements, namely; (1) An increased efficiency in the facilities for handling the heavy traffic; (2) the increased capacity of cars; and (3) the increased power of locomotives.

However to begin with, there is one important factor that must not be forgotten when the decreased cost of transportation is talked of and that is the enormous decrease in the price of steel. The importance of the use of in all railroad construction is well known. Mr. Newcomb in his "Railway Economics" in speaking of the importance of the reduction of the price of steel rails says, "The substitution of steel for iron as the material from which rails are made and in later years of heavier rails, has been greatly fostered by the progressive reduction in the cost of rails attributable to improvements in steel and rail-making processes. The manufacture of steel rails in commercial quantities in the United States began



in 1867. The average price during that year was \$120.12 per ton. In 1880, the price had declined \$67.50, and 29 per cent of all railway track in the country were composed of steel rails. The price in 1890 was \$31.75 and 80 per cent of all track was of steel; in 1896, the price was \$28. and but 12 per cent of the total trackage remained of iron. Heavier locomotives, larger cars, faster and larger trains are secondary consequences of the reduced cost of steel rails and these increase the efficiency of the trains as a machine for moving commodities". This argument goes a great way in the explanation of how the railways have given assistance to the productive industries which service has reflected to them in the way of reduced prices of the productions.

It needs no argument to prove that the increased efficiency in the facilities for handling the traffic in the form of heavy rails, steel bridges, good ballast, and increased terminal facilities has done a great deal to decrease the cost of transportation. In fact, while these improvements have meant large expenditures it was only through these vast expenditures that an increased weight of locomotives and cars and the consequent increased volume of traffic has been made possible.

Referring to Chart No. showing the "average number of tons carried one mile", the steady and yet rapid increase of this particular tonnage is explained by the increased capacity of the cars and the decreased per cent of dead weight. Twenty five years ago, the average freight box car in the United States had a capacity ranging from 16000 lbs. up to 24000 lbs., a total outside length of 28 ft. 2 ins., and an outside width of 8 ft. 8 in. Then in 1861, the 40000 lb. car was introduced with a total length of 34 ft. 9 in.



and a width increased to 9 ft. 1 in.; this in 1885, was followed by the 60000 lb. car with a total length of 36 ft. 9 in. and 9 ft. 1 in. in width. In 1898, cars were constructed having a capacity of 80000 lb. and in 1901, box cars were made with a capacity of 100000 lbs. having a total outside length of 37 ft. 2 in. and 9 ft. 5 in. in width. But compare the capacity, which represents paying freight, to the dead weight as shown by the following table taken from the Pennsylvania Railway Report:-

Date of adoption	Capacity	Weight of Empty Car	Per Cent of Dead Weight
1879	24000	20,300	.84
1881	40000	24,900	.60
1885	60000	30,000	.50
1898	80000	35,300	.44
1901	100000	45,300	.45

The above table serves to indicate not only the way in which the paying load has been increased but also leads to other conclusions e.g.- a reduced number of cars in use and a reduced empty car movement and the consequent reduction of capital engaged; shorter trains for given tonnage and the increased paying load hauled by each locomotive; and the available capacity of the permanent way is utilized to a greater extent.

These are some of the results of increased capacity of cars which have served to reduce the rates.

This period of larger cars is likewise the period of more powerful locomotives. These have so far increased in size that they now represent a weight upon the driving wheels of 160000 to 176000 pounds while the latest type of locomotive of all for use on heavy goods, has a total weight on drivers of 200000 lbs. or





more. The "Atlantic" type of engine which is now in common use on most of the eastern roads on fast freight trains has a total weight of 176000 lbs., exclusive of tender, and is provided with a traction increaser which supplies a temporary addition of 10000 lbs. to be used in starting. Another leading feature of the present locomotive is the fact that a wide fire box permits of a larger grate area than has been possible hereto-fore, giving a greater efficiency in the consumption of fuel and the evaporation of water and greater ease in stoking engines of so large a size.

From the foregoing argument, one may grasp some of the principal reasons for the decline of rates. Many secondary causes might be shown, such as the interchange of cars, unification of the traffic relations etc.; but space will not permit.



American vs. European Freight Transportation.

When one endeavors to compare the freight transportation of Europe with that of America, it must be remembered that the conditions under which the services are performed are very different from those existing in this country. In America railroads are built and service constantly being improved with the object in view of greater efficiency of conducting freight traffic and thereby increasing the ton-mile revenue. In Europe owing to the density of the population, the passenger traffic is the one which is the greatest source of revenue and is consequently the branch of service the efficiency of which secures the most attention.

In America as has been presented, railroads have a large amount of traffic and, by interline agreement or otherwise, haul it over a considerable distance in cars of large capacity. In Europe, however, the ton-milage is small and the capacity of the cars is small being an average only of 5 tons. Furthermore, it is impracticable to increase the capacity since the terminal facilities are so small. In other words, European railway conditions are such that a large ton-milage and consequently a large ton-mile revenue is impossible and in America, every condition is such that large ton-milage is not only possible but in such a degree that the same exceeds the aggregate ton-milage of Europe.

From what has been said, it would be inferred that the freight charges in the United States are much lower than those of Europe and the decline is much more rapid. The average ton mile revenue that has been received by the total milage of the United States was .75 cents in 1901. In 1891, the average was, .895 ¢ and during the years from 1871-1881 the average fell almost one third, the lowest





average ever reached was in 1899 when it fell to .724 since which time the problem among the railroads of the United States has not been how to secure or increase the freight business but how to transport efficiently the immense quantity that was offered them. In fact, after charges have been lowered in times of business depression to secure traffic, they have been advanced in good times in order to discourage it until the traffic could be disposed of. Of course this is only temporary and when the times are normal the rates are again lowered.

In Great Britain, there are no available statistics showing the revenue per ton-mile. The revenue has been estimated by Mr. Pratt to be "somewhat more than 2¢. However, the conclusion must not be drawn that the average rates are two and two-thirds those of this country because the rates very frequently include charges for the collection and delivery of goods. All then that can be said of British rates as compared with American rates is that they are higher but how much higher can not be estimated.

The rates of both France and Germany may fall under the same classification and seem to be a mixture of fast freight, special and preferential rates having no adopted standard whatever. In 1899, the rate per ton (2.20 ¢ lb.) mile was 1.42¢ while on the railroads in France, it was 1/55 ¢. In Russia, the rate is from 4.2 ¢ to 2.3 ¢ for any shipment less than 10 tons according to the length of haul, and represents about 20% of the total tonage. About 17% is carried at "special" rates and the remaining 63% is hauled at preferential rates which Mr. Pratt says in his "American Railroads" to be officially described to be applicable to agricultural and industrial products and intended to facilitate import and export and



increase the traffic of the country" He further says, "The preferential tariffs are employed as a bounty to enable certain sections of Germany to export their products; as an export bounty on the trade of Germany with the countries about the eastern Mediterranean; as an aid to ship-building; as an aid to manufactures by cheap rates on fuel; and as a means of relieving the distress of any portion of the country that may have suffered from floods or bad harvests".

In France, the railways are under immediate government supervision, each road having a monopoly tributary to it. Here, the tariffs are different on each of the six separate systems. The normal charges, however, are particularly high, but their effects upon the average ton-mile revenue are largely overcome by the special and preferential rates existing on each line.

In Austria and Hungary, the "zone principle" is applied to the freight business, and the charges for long distances are proportionally less than for short distances. The rates vary with the class and quality of the goods shipped. However these countries differ from their European neighbors in that they have a classification though simple and and there are few exceptions to the classification. The revenue per ton-mile for ordinary freight in 1900 was 1.16 ¢ on Hungarian roads and 1.3¢ on Austrian State roads.

In stating the cause for the difference in freight rates in this country and in Europe, we have referred to the dense traffic shipped long distances. In the United States in 1901, the average distance traveled by a ton of freight was 252 miles; in Germany, 60 miles; in France, 80 miles; on the Austrian State roads, 80 miles; and in Italy, 70 miles. Hence the freight rates in the United States is and must necessarily be low since a large share of the tonnage is



shipped in carloads and train-loads hundreds of miles.

Other conditions such as the lower number of employes per mile of road in America as compared with Europe and the cheapness in fuel have placed the American rates in their present low state. Mr.C.Johnson says "The most important causes of low rates have their influences which have resulted in superior technical efficiency of the American freight service as compared with European countries". This is a result of competition which compelled the roads to reduce the movement cost to the lowest possible level, and although, with the exception of France, the competitive element is not absent, the stress of rivalry has been far greater in America than in Europe.

#### Conclusion.

It has been the purpose of this essay to discuss some of the principal points dealing with the cost of freight transportation. It has been written from from the economic point of view as well as the practical with the object to combine the two in such a way that some insight may be given as to the existing conditions regarding the cost of the freight service. The importance of the traffic as a whole can not be over estimated. The growth of the country as well as the present era of prosperity are, without question, the direct result of the enormous transportation facilities at our command. The industry has grown to such large proportions in such a small space of time, that those who have the management, are without sufficient experience to undertake a statement of the actual costs of the service, without a thorough investigation for the purpose of establishing rates on a systematic basis. They must make the rates to suit the conditions which must, for the present at least, be left to their judgment.





A number of different remedies have been from time to time suggested to the Inter State Commerce Commission through Congress or interested parties whereby the rates may be standardized. In the last session of Congress, a bill was introduced giving the Commission the right to regulate rates. In fact present indications are that those who are giving the subject time and thought agree that there is no one or even such an experienced body as the Commission is capable of forming a rate schedule to suit the conditions. They do not feel that the "time is ripe".

However, there is a policy of instituting economies in the engineering departments of the road. This fact illustrated by the growing tendency in this direction. As in any productive industry a thorough understanding of the cost of production and the means of its further reduction reflects on the economic conditions of the country to render it healthful. It is at just such a point that the railroads now find themselves. They are striving to lower their charges through economies in the service as well as in thorough organization so that the services of capable engineers are indispensable.

Therefore, in some future time when the railroad as a private or public institution has become to be known and thoroughly understood, it will then be time either by the company themselves or by state or federal commission or both to establish a uniform system of rates to be used over the whole United States.







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